

PATENT

Atty. Dkt. No. APPM/008716/ETCH/SILISON/PJS

**REMARKS**

This is intended as a full and complete response to the Final Office Action dated March 22, 2006, having a shortened statutory period for response set to expire on June 22, 2006. Please reconsider the claims pending in the application for reasons discussed below.

Claims 1, 3, 4, 6-18, 20, 21, and 23-33 remain pending in the application and are shown above. Claims 35-49 have been cancelled by Applicant without prejudice. Claims 1, 3, 4, 6-18, 20, 21 and 23-33 stand rejected. Reconsideration of the rejected claims is requested for reasons presented below.

**Claims 1, 3-4, 6-7, 17-18, 20 and 23-24**

Claims 1, 3-4, 6-7, 17-18, 20 and 23-24 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *Toprac* (U.S. Patent No. 6,379,980) in view of *Payne* (U.S. Patent No. 5,329,381), as evidenced by *Wilby* (U.S. Publ. No. 2003/0141572). Applicant respectfully traverses the rejection.

The combination of *Toprac*, *Payne*, and *Wilby* does not motivate the present invention. *Toprac* teaches measuring the thickness of a process layer, removing at least a portion of the process layer until an end point of the removal process is reached, determining a removal rate based on the measured thickness, and comparing the removal rate to an expected removal rate. The Examiner acknowledges that *Toprac* does not disclose applying an outlier filter to remove outliers in the pre-etch measurement information, but relies on *Payne* to disclose an outlier filter. *Payne* discloses an automatic engraving system that scans, samples, and resizes an image. Noise is removed from the image using an outlier noise filter. The disclosed outlier filter is specifically directed toward images, in that it compares the intensity of each pixel in the image to the average intensity of its 8 neighboring pixels. If the difference is greater than a threshold value, the intensity value is replaced by its neighborhood value. (Page 6, paragraph [0038].) Because *Payne* teaches an outlier filter for use in digital image processing while *Toprac* teaches a method for monitoring a material removal tool used in semiconductor device manufacturing, the kinds of data analyzed are completely

Page 7

454810\_1

PATENT

Atty. Dkt. No. APPM/006716/ETCH/SILICON/PJS

different and non-related. Thus, there is no motivation of the claimed subject matter from the combined disclosures of *Toprac* and *Payne*.

Therefore, the combination of *Toprac*, *Payne*, and *Wilby* does not teach, show, or suggest a method for monitoring an etch process, comprising performing pre-etch measurements of a substrate to generate pre-etch measurement information, applying an outlier filter to remove outliers in the pre-etch measurement information, providing the substrate along with the pre-etch measurement information to an etch reactor, etching the substrate in the etch reactor using an etch process, wherein the pre-etch measurement information in combination with etch process monitoring are used to monitor an etch process endpoint, and terminating the etch process based on the etch process monitoring having identified that the etch process has reached the etch process endpoint, as recited in claim 1 and claims dependent thereon. Withdrawal of the rejection is respectfully requested.

Furthermore, the combination of *Toprac*, *Payne*, and *Wilby* does not teach, show, or suggest a method for monitoring an endpoint of a mask trimming process, comprising performing pre-etch measurements of a substrate having a mask thereon to generate pre-etch measurement information of such mask, applying an outlier filter to remove outliers in the pre-etch measurement information, providing the substrate along with the pre-etch measurement information to an etch reactor, trimming the mask using an etch process, wherein the pre-etch measurement information in combination with etch process monitoring are used to monitor a trim process, and terminating the trim process when the etch process monitoring indicates that the mask has been trimmed to pre-determined dimensions, as recited in claim 18 and claims dependent thereon. Withdrawal of the rejection is respectfully requested.

**Claims 1, 3-4, 6-9, 11-13, 15, 17-18, 20, 23-26, 28-30 and 32**

Claims 1, 3-4, 6-9, 11-13, 15, 17-18, 20, 23-26, 28-30 and 32 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *Klippert II et al* (U.S. Patent No. 6,136,712) in view of *John H. Payne* (U.S. Patent No. 5,329,381). Applicant respectfully traverses the rejection.

Page 8

454810\_1

## PATENT

Atty. Dkt. No. APPM/006716/ETCH/SILISON/PJS

The combination of *Klippert II* and *Payne* does not motivate the present invention.

*Klippert II* teaches an automated process which measures the thickness of a masking layer prior to etching. The masking layer thickness and real-time measurements control when etching is terminated. The Examiner acknowledges that *Klippert II* does not disclose applying an outlier filter to remove outliers in the pre-etch measurement information, but relies on *Payne* to disclose an outlier filter. *Payne* discloses an automatic engraving system that scans, samples, and resizes an image. Noise is removed from the image using an outlier noise filter. The disclosed outlier filter is specifically directed toward images, in that it compares the intensity of each pixel in the image to the average intensity of its 8 neighboring pixels. If the difference is greater than a threshold value, the intensity value is replaced by its neighborhood value. (Column 8, lines 17-24.) Because *Payne* teaches an outlier filter for use in digital image processing while *Klippert II* teaches a method for monitoring a material etch process used in semiconductor device manufacturing, the kinds of data analyzed are completely different and non-related. Thus, there is no motivation of the claimed subject matter from the combined disclosures of *Klippert II* and *Payne*.

Therefore, the combination of *Klippert II* and *Payne* does not teach, show, or suggest a method for monitoring an etch process, comprising performing pre-etch measurements of a substrate to generate pre-etch measurement information, applying an outlier filter to remove outliers in the pre-etch measurement information, providing the substrate along with the pre-etch measurement information to an etch reactor, etching the substrate in the etch reactor using an etch process, wherein the pre-etch measurement information in combination with etch process monitoring are used to monitor an etch process endpoint, and terminating the etch process based on the etch process monitoring having identified that the etch process has reached the etch process endpoint, as recited in claim 1 and claims dependent thereon. Withdrawal of the rejection is respectfully requested.

Furthermore, the combination of *Klippert II* and *Payne* does not teach, show, or suggest a method for monitoring an endpoint of a mask trimming process, comprising performing pre-etch measurements of a substrate having a mask thereon to generate

## PATENT

Atty. Dkt. No. APPM/006716/ETCH/SILICON/PJS

pre-etch measurement information of such mask, applying an outlier filter to remove outliers in the pre-etch measurement information, providing the substrate along with the pre-etch measurement information to an etch reactor, trimming the mask using an etch process, wherein the pre-etch measurement information in combination with etch process monitoring are used to monitor a trim process, and terminating the trim process when the etch process monitoring indicates that the mask has been trimmed to pre-determined dimensions, as recited in claim 18 and claims dependent thereon. Withdrawal of the rejection is respectfully requested.

**Claims 1, 3-4, 6-9, 11-13, 15, 17-18, 20, 23-26, 28-30 and 32**

Claims 1, 3-4, 6-9, 11-13, 15, 17-18, 20, 23-26, 28-30 and 32 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *Petrucci et al* (WO 01/24254) in view of *John H. Payne* (U.S. Patent No. 5,329,381). Applicant respectfully traverses the rejection.

The combination of *Petrucci* and *Payne* does not motivate the present invention. *Petrucci* teaches an etch method which includes the steps of measuring a thickness of a mask layer on top of a substrate, measuring the depth of a recess during an etching step, and stopping the etching step when the depth value reaches a sum of the target depth value and the thickness value. The Examiner acknowledges that *Petrucci* does not disclose applying an outlier filter to remove outliers in the pre-etch measurement information, but relies on *Payne* to disclose an outlier filter. *Payne* discloses an automatic engraving system that scans, samples, and resizes an image. Noise is removed from the image using an outlier noise filter. The disclosed outlier filter is specifically directed toward images, in that it compares the intensity of each pixel in the image to the average intensity of its 8 neighboring pixels. If the difference is greater than a threshold value, the intensity value is replaced by its neighborhood value. (Column 8, lines 17-24.) Because *Payne* teaches an outlier filter for use in digital image processing while *Petrucci* teaches a method for monitoring a material etch process used in semiconductor device manufacturing, the kinds of data analyzed are completely different and non-related. Thus, there is no motivation of the claimed subject matter from the combined disclosures of *Petrucci* and *Payne*.

PATENT

Atty. Dkt. No. APPM008716/ETCH/SILISON/PJS

Therefore, the combination of *Petrucci* and *Payne* does not teach, show, or suggest a method for monitoring an etch process, comprising performing pre-etch measurements of a substrate to generate pre-etch measurement information, applying an outlier filter to remove outliers in the pre-etch measurement information, providing the substrate along with the pre-etch measurement information to an etch reactor, etching the substrate in the etch reactor using an etch process, wherein the pre-etch measurement information in combination with etch process monitoring are used to monitor an etch process endpoint, and terminating the etch process based on the etch process monitoring having identified that the etch process has reached the etch process endpoint, as recited in claim 1 and claims dependent thereon. Withdrawal of the rejection is respectfully requested.

Furthermore, the combination of *Petrucci* and *Payne* does not teach, show, or suggest a method for monitoring an endpoint of a mask trimming process, comprising performing pre-etch measurements of a substrate having a mask thereon to generate pre-etch measurement information of such mask, applying an outlier filter to remove outliers in the pre-etch measurement information, providing the substrate along with the pre-etch measurement information to an etch reactor, trimming the mask using an etch process, wherein the pre-etch measurement information in combination with etch process monitoring are used to monitor a trim process, and terminating the trim process when the etch process monitoring indicates that the mask has been trimmed to pre-determined dimensions, as recited in claim 18 and claims dependent thereon. Withdrawal of the rejection is respectfully requested.

**Claims 1, 3-4, 6-9, 11-13, 15, 17-18, 20, 23-26, 28-30 and 32**

Claims 1, 3-4, 6-9, 11-13, 15, 17-18, 20, 23-26, 28-30 and 32 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *Grimbergen et al* (U.S. Patent No. 6,390,019) in view of *John H. Payne* (U.S. Patent No. 5,329,381). Applicant respectfully traverses the rejection.

The combination of *Grimbergen* and *Payne* does not motivate the present invention. *Grimbergen* teaches measuring the thickness of the layer to be etched on a substrate, transferring the substrate from a load-lock transfer chamber by a robot arm

Page 11

454810\_1

## PATENT

Any. Oki. No. APPM/006716/ETCH/SILICON/PJS

through a slit valve and into a process chamber, using the layer thickness to estimate operating conditions, monitoring the process by a process monitoring system to change conditions or to stop the etching process. The Examiner acknowledges that *Grimbergen* does not disclose applying an outlier filter to remove outliers in the pre-etch measurement information, but relies on *Payne* to disclose an outlier filter. *Payne* discloses an automatic engraving system that scans, samples, and resizes an image. Noise is removed from the image using an outlier noise filter. The disclosed outlier filter is specifically directed toward images, in that it compares the intensity of each pixel in the image to the average intensity of its 8 neighboring pixels. If the difference is greater than a threshold value, the intensity value is replaced by its neighborhood value. (Column'8, lines 17-24.) Because *Payne* teaches an outlier filter for use in digital image processing while *Grimbergen* teaches a method for monitoring a material etch process used in semiconductor device manufacturing, the kinds of data analyzed are completely different and non-related. Thus, there is no motivation of the claimed subject matter from the combined disclosures of *Grimbergen* and *Payne*.

Therefore, the combination of *Grimbergen* and *Payne* does not teach, show, or suggest a method for monitoring an etch process, comprising performing pre-etch measurements of a substrate to generate pre-etch measurement information, applying an outlier filter to remove outliers in the pre-etch measurement information, providing the substrate along with the pre-etch measurement information to an etch reactor, etching the substrate in the etch reactor using an etch process, wherein the pre-etch measurement information in combination with etch process monitoring are used to monitor an etch process endpoint, and terminating the etch process based on the etch process monitoring having identified that the etch process has reached the etch process endpoint, as recited in claim 1 and claims dependent thereon. Withdrawal of the rejection is respectfully requested.

Furthermore, the combination of *Grimbergen* and *Payne* does not teach, show, or suggest a method for monitoring an endpoint of a mask trimming process, comprising performing pre-etch measurements of a substrate having a mask thereon to generate pre-etch measurement information of such mask, applying an outlier filter to remove outliers in the pre-etch measurement information, providing the substrate along with the

## PATENT

Atty. Dkt. No. APPM006716/ETCH/SILISON/PJS

pre-etch measurement information to an etch reactor, trimming the mask using an etch process, wherein the pre-etch measurement information in combination with etch process monitoring are used to monitor a trim process, and terminating the trim process when the etch process monitoring indicates that the mask has been trimmed to pre-determined dimensions, as recited in claim 18 and claims dependent thereon. Withdrawal of the rejection is respectfully requested.

**Claims 10, 20 and 27**

Claims 10, 20 and 27 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *Anthony J. Toprac* (U.S. 6,379,980) in view of *John H. Payne* (U.S. 5,329,381) as applied to claims 1, 3-4, 6-7, 17-18, 20 and 23-24 and further in view of *Bin Yu* (U.S. Patent No. 6,368,982). Applicant respectfully traverses the rejection.

The teachings of *Toprac* and *Payne* are described above. As described above, the combination of *Toprac* and *Payne* does not does not motivate the present invention as recited in independent claims 1 and 18. The examiner relies on *Yu* as teaching that during a mask trim the mask undergoes etching from all sides and leaves a scaled down length and that the two sides and the top are trimmed by substantially the same trim length. Thus, *Yu* does not cure the motivation deficiency of the *Toprac* and *Payne* combination. Accordingly, Applicant respectfully requests that these rejections be withdrawn and the claims allowed.

**Claims 14 and 31**

Claims 14 and 31 stand rejected under 35 U.S.C. § 102(b) as being unpatentable over *Klippert II et al* (U.S. Patent No. 6,136,712) in view of *John H. Payne* (U.S. Patent No. 5,329,381) as applied to claims 1, 3-4, 6-9, 11-13, 15, 17-20, 23-26, 28-30 and 32 and further in view of *Nakada et al* (JP 11-251252). Applicant respectfully traverses the rejection.

The teachings of *Klippert II* and *Payne* are described above. As described above, the combination of *Klippert II* and *Payne* does not motivate the present invention as recited in independent claims 1 and 18. The examiner relies on *Nakada* as teaching that light having a desired wavelength and modulation of intensity is used for monitoring

## PATENT

Atty. Dkt. No. APPM006716/ETCH/SILISON/PJS

a plasma. Thus, *Nakada* does not cure the motivation deficiency of the *Klippert II* and *Payne* combination. Accordingly, Applicant respectfully requests that these rejections be withdrawn and the claims allowed.

**Claims 16 and 33**

Claims 16 and 33 stand rejected under 35 U.S.C. § 102(b) as being unpatentable over *Grimbergen et al* (U.S. 6,390,019) in view of *John H. Payne* (U.S. Patent No. 5,329,381) as applied to claims 1, 3-4, 6-9, 11-13, 15, 17-20, 23-26, 28-30 and 32 and further in view of *Grimbergen et al* (U.S. Patent No. 6,406,924, hereinafter *Grimbergen II*). Applicant respectfully traverses the rejection.

The teachings of *Grimbergen* and *Payne* are described above. As described above, the combination of *Grimbergen* and *Payne* does not motivate the present invention as recited in independent claims 1 and 18. The examiner relies on *Grimbergen II* as teaching that as the structures are etched, the minimas and maxima of the interferometric signal shift because the position of minima and maxima are indicative of etch depth. Thus, *Grimbergen II* does not cure the motivation deficiency of the *Grimbergen* and *Payne* combination. Accordingly, Applicant respectfully requests that these rejections be withdrawn and the claims allowed.

**Claim 21**

Claim 21 stands rejected under 35 U.S.C. § 102(b) as being unpatentable over *Anthony J. Toprac* (U.S. Patent No. 6,379,980) in view of *John H. Payne* (U.S. Patent No. 5,329,381) as applied to claims 1, 3-4, 6-7, 17-18, 20 and 23-24 and further in view of *Cha et al* (U.S. Patent No. 6,319,767). Applicant respectfully traverses the rejection.

The teachings of *Toprac* and *Payne* are described above. As described above, the combination of *Toprac* and *Payne* does not motivate the present invention as recited in independent claims 1 and 18. The examiner relies on *Cha* as teaching that the photoresist mask is reduced by plasma. Thus, *Cha* does not cure the motivation deficiency of the *Toprac* and *Payne* combination. Accordingly, Applicant respectfully requests that these rejections be withdrawn and the claims allowed.



## PATENT

Atty. Dkt. No. APPM/006716/ETCH/SILISON/PJS

In conclusion, the references cited by the Examiner, alone or in combination, do not teach, show, or suggest the invention as claimed.

Having addressed all issues set out in the Final Office Action, Applicant respectfully submits that the claims are in condition for allowance and respectfully request that the claims be allowed.

Respectfully submitted,



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